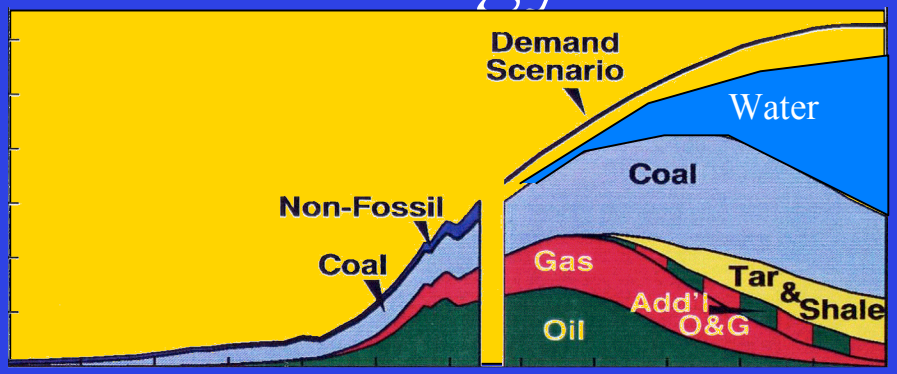
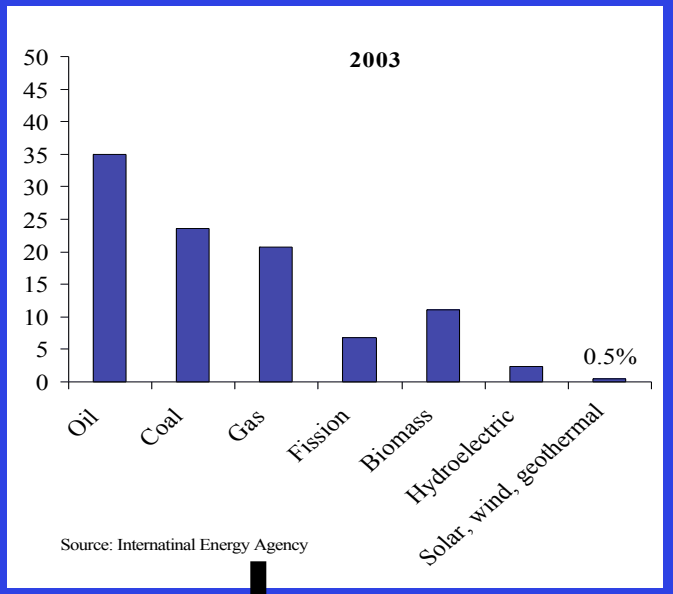
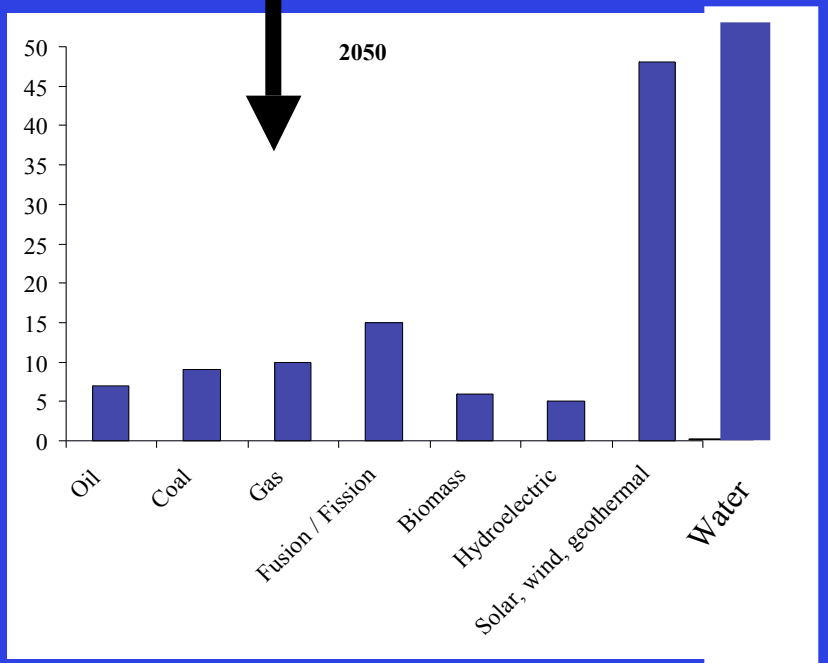
Grand Energy and Environmental Challenges





All technologies envisioned to meet future energy and environmental demands require advances in fundamental Geosciences:

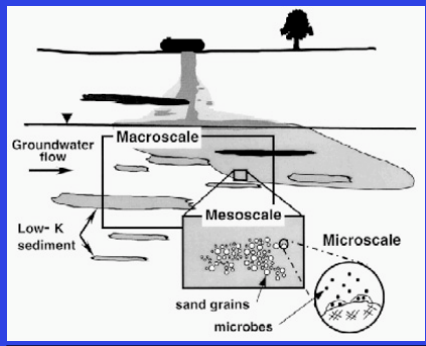
- * Fossil (oil, gas coal)
- * Nuclear
- * Hydrogen
- * Biomass
- * Renewable (wind, solar geothermal)
- * Water supply



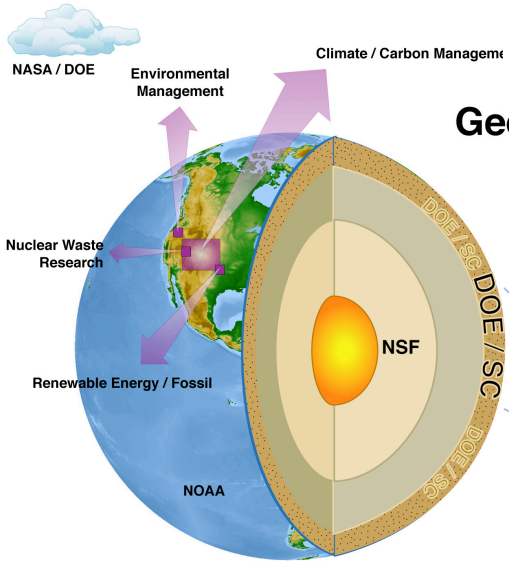
(modified from R. E. Smalley, Rice University
BES Symposium 4/29/03)

Long Term Goals: **Develop fundamental understanding of complex, coupled processes that will permit imaging and manipulation of the ecosphere for improved management and exploitation**

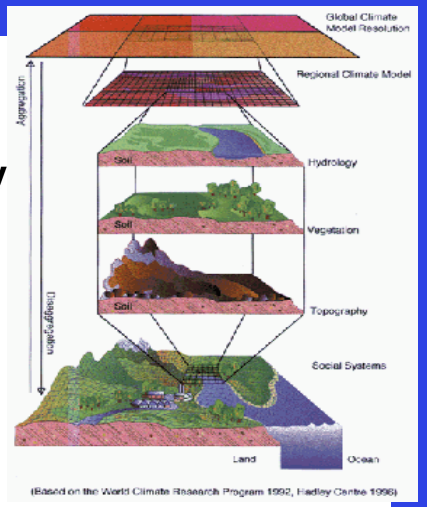
* sustainable resource development (water, fossil fuels)
  * environmental remediation
  * climate change prediction
  * safe nuclear waste disposal

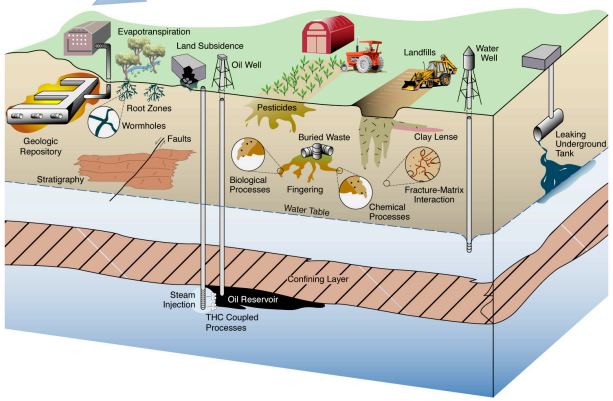


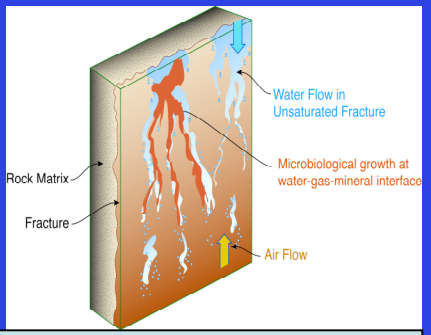
Scaling



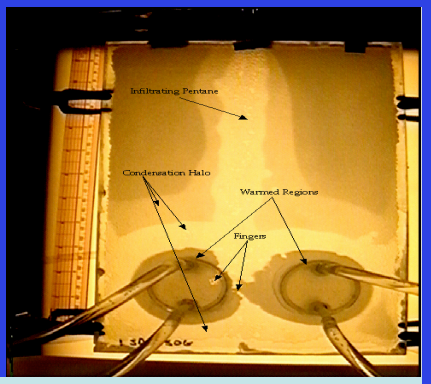
Geosciences / Env







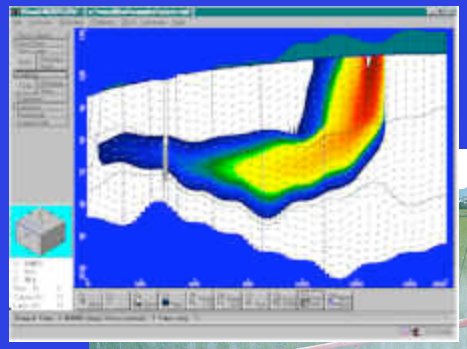
Process Prediction

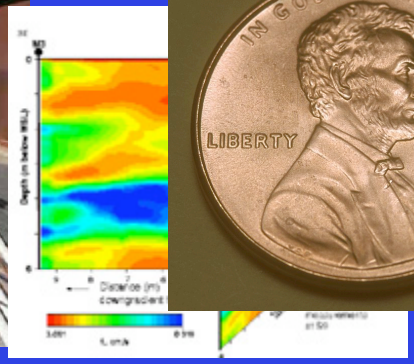


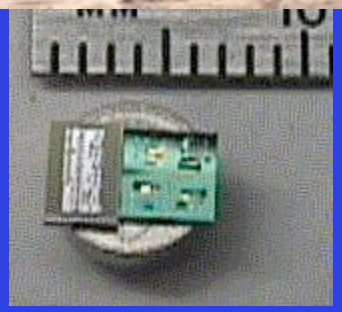
Ecosphere Manipulation

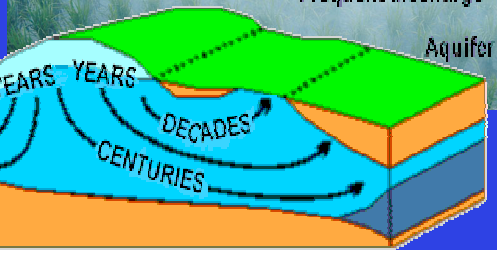
Crosscutting Obstacles-

* next generation **sensor** development and emplacement
* **imaging** and multi-scale, multi-sensor data integration
*model **prediction** of processes over various length and time scales and **uncertainty** quantification
* **ecosphere manipulation** for sustainable resource development and environmental remedation
ETC



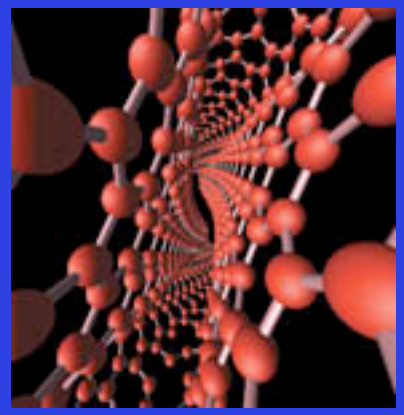


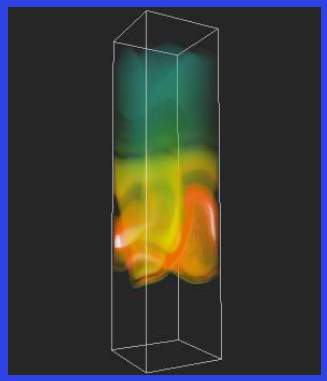


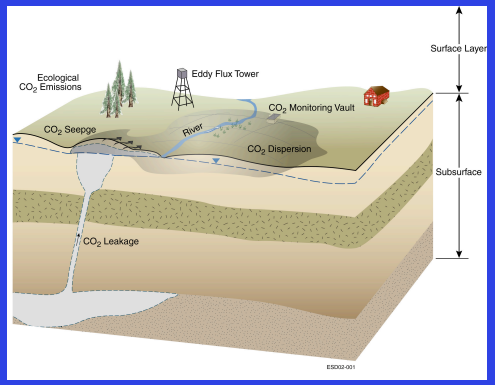


Implementation Mechanism

- **Underground and surface facilities focused on critical crosscutting issues**
  - **Eliminate major roadblocks for improving current and advanced energy production**
  - **Balance adequate environmental protection with economic growth**
  - **Use natural analogs for complex process understanding**
- **Draw on unique expertise and form critical mass through integrated "Manhattan" style projects**
  - **Nano-scale to macro-scale**
  - **Integrate diverse expertise to supply innovative and cost effective solutions**







Impact

- Advanced technology base to support:
  - Optimal domestic oil and gas extraction
  - CO_2 sequestration
  - Nuclear waste disposal
  - Optimize and protect water resources
  - Environmental cleanup
  - Climate Change
  - Renewable energy
  - Advanced energy sources
  - Coal and mineral resource utilization

Summary

- For the next 50 years we will be in a carbon constrained energy supply
  - Broad implications on current domestic resources and economic vitality
- We must smoothly transition to other energy sources
  - Optimize current domestic resources while developing new ones (no magic bullets)
- Fundamental geoscience research is critical for supporting every envisioned technology essential for this transition
- We are running out of time, new paradigms must be developed for meeting the challenge
  - Link fundamental research to applied needs
  - Form critical mass in selected projects to address major rodablocks